

16. PORTUGAL

This country fiche provides a comprehensive overview and assessment of climate change adaptation in Portugal. After detailing the vulnerability of Portugal's coastal zones, the responsibility and financing for coastal protection is explained. Next, the fiche presents the relevant research activities, the coastal defence, risk reduction and adaptation plans available in Portugal as well as the current and future protection and adaptation expenditure. The persons contacted and sources of information used are listed at the end.

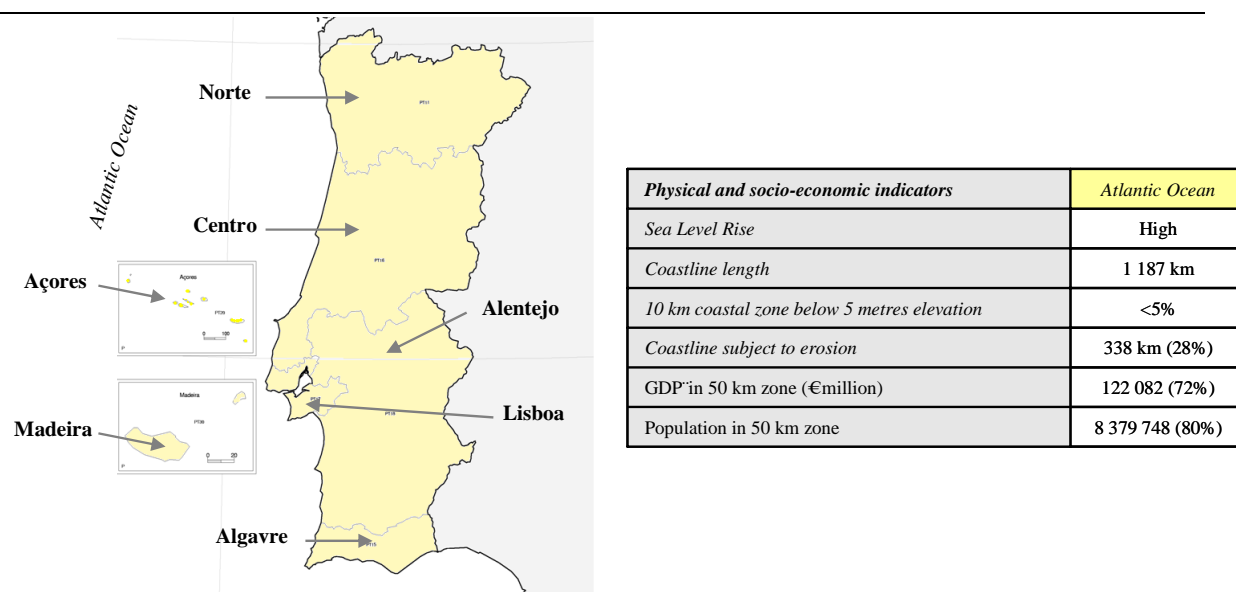
16.1. VULNERABILITY OF PORTUGAL'S COASTAL ZONES TO CLIMATE CHANGE

Portugal is situated in south-western Europe, bordering the Atlantic Ocean in the west and Spain in the east. From an administrative point of view, the country consists of 18 districts, further divided into 308 municipalities, and two autonomous regions Azores and Madeira¹. Portugal operates in a highly centralised way which implies that in practice the municipalities have relatively limited responsibilities.

Coastal Management Plans in continental Portugal are organised around five different areas, illustrated in *Figure 16-1*. Furthermore, an overview is given of the main physical and socio-economic indicators of the coastal zones.

¹ Climate change impact and adaptation of the outermost regions have been described in a dedicated country fiche.

Figure 16-1: Coastal regions of Portugal and their main physical and socio-economic indicators



Source: Policy Research based on EEA, 2006, *The changing faces of Europe's coastal areas* (for Sea Level Rise and 10 km coastal zone below 5 metres elevation); European Commission (EuroSION study), 2004, *Living with coastal erosion in Europe: Sediment and space for sustainability* (for coastline length and coastline subject to erosion); Eurostat 2004 (for GDP and population in 50 km zone)

The total coastline of Portugal measures 1187 km. The mainland is mainly at risk of Sea Level Rise (SLR) and changes in both the direction and the power of waves and storm surges. Consequently, the main climate change impacts for the Portuguese coastal zone include the (permanent) inundation of dry- and wetland in low-lying areas as well as accelerated erosion. The following paragraphs describe in more detail the vulnerability of Portugal's coastal zones to the risk of flooding and erosion, freshwater shortage and potential loss of eco-systems.

a/ Flooding and erosion

The Portuguese coast has a wide variety of features which can be classified in 4 main types: beaches, wetlands, hardened and cliffed coasts. About 60% of the population inhabits the coastal zone, where most of the larger cities² are situated, rising up to 80% in the touristic summer months.

The continental Atlantic coast of Portugal faces a growing threat of coastal erosion. Most of the sandy shorelines are affected by erosion, with retreat rates in some instances of up to a few metres per year. High-energy waves and the intense long-shore sediment drift³ make the western continental coast

² Portuguese coastal cities include Oporto, Aveiro, Lisbon, Setubal and Faro.

³ Long-shore sediment drift is the process by which beach material is transported along the coast by the action of waves; whenever waves approach the coastline at an angle, they push beach material up the beach at the same angle and when the water then retreats the material is dragged back at a 90° angle which produces a zig-zag movement of sediment along

naturally vulnerably to erosion. The human modification of river networks, principally by the construction of dams, has furthermore drastically reduced sediment supply to coastal regions aggravating the problem.

The high rates of erosion make the Portuguese coastal zones increasingly vulnerable to climate change and especially to rises in sea level. The coastal zones north of Lisbon and the Algarve barrier coast are considered most exposed.

b/ Freshwater shortage

Over the years Portugal did not have serious water shortage problems under normal hydrological conditions. To date, the water resources available in continental Portugal are sufficient to satisfy current needs of consumers, which are represented for 87% by the agricultural sector.

Nevertheless, seasonal and annual variability in rainfall⁴ and consequently in water availability contributes to a geographical and temporal mismatch between water availability and water demand. This is particularly accentuated in the south of the country, notably the Algarve. This irregularity is responsible for a significant number of water stress situations and complicates water resources management in Portugal.

In addition to the availability of water, water quality will become of increasing importance. This is due to the intrusion of saline water as well as the degradation of water quality in water bodies as a result of industrialisation and the increasing population density.

Over the past years, significant expenditure was already made to upgrade the existing water supply infrastructure. Currently studies are underway concerning adaptation to climate change in the water resources sector, coordinated by the Portuguese water institute INAG.

c/ Loss of coastal eco-systems

Erosion and SLR cause a significant threat to the Portuguese wetlands situated in lagoonal and estuarine environments. Some marshes and wetland areas may cope with the increased sea level through upward and landward displacement. However, many of these areas are situated in front of man-made infrastructure to protect salt-works and fish farms as well as to control floods, limiting the

the beach; long-shore sediment drift causes environment problems as it can decimate beaches by literally washing them away.

⁴ The annual precipitation may vary three-fold from year to year and five-fold from the dry interior south to the wet mountainous north-west. Furthermore, climate change precipitation models predict a drier climate in Portugal, with a shorter and wetter rainy season, followed by a long dry summer. The reduction in mean precipitation is expected to affect the southern parts of the country, notable the Algarve, the most. This area is also projected to experience increasing pressure from tourism which will require better demand management measures.

potential for landward migration. This situation of coastal squeeze may ultimately lead to the loss of these areas.

The main coastal lagoons areas in Portugal are Ria de Aveiro and Ria Formosa respectively situated in the centre of Portugal and Algarve.

16.2. RESPONSIBILITY AND FINANCING FOR COASTAL PROTECTION AND CLIMATE ADAPTATION

In Portugal, coastal defence is mainly dealt with at national level. The responsible authority depends on the type of coastal area. The main actors involved are the *Ministry for Environment, Spatial Planning and Regional Development*, the *Port Administrations* and the *Ministry of Defence*. In the autonomous regions of Azores and Madeira, the regional governments have the responsibility of developing plans for their coastal zones.

The *Ministry for Environment, Spatial Planning and Regional Development* (MAODTR) is responsible for the Public Maritime Domain (PMD), a 50 m coastal strip which is mainly preserved from occupation and in which land can not be turned into private property. As a result, the state is responsible for providing and funding protection if erosion affects an area landward of the PMD zone. The *Port Administrations*⁵ are responsible for port areas and the *Ministry of Defence* has responsibility for areas under military administration.

Furthermore, the whole Portuguese continental coastal zone is covered by nine Coastal Zone Spatial Plans (POOCs)⁶ which have all been approved and published. The development of the plans was supervised by the *Water Institute INAG* and in protected areas by the *Nature and Biodiversity Conservation Institute*. The Water Institute furthermore implements the coastal defence works and takes care of maintenance. Both institutes are subordinated to the MAODTR who ensures the overall coordination through a Strategic Coordination Group.

Funding is provided by the state but is also obtained through the EU Structural and Cohesion Funds. The Port Administrations and the Ministry of Defence are responsible for financing measures in port areas and military areas, respectively.

With respect to the provision of freshwater resources, the *National Institute for Water INAG* is the ‘environment authority’, responsible for water resource management. INAG is supported by *IRAR, the Institute for the Regulation of Water and Solid Waste*.

⁵ The Port Administrations refer to the port authorities as well as the national maritime administration, depending on the administrative regime of each port.

⁶ ‘POOC’ stands for ‘Planos de Ordenamento da Orla Costeira’.

16.3. RESEARCH INTO PORTUGAL'S VULNERABILITY TO CLIMATE CHANGE AND CLIMATE CHANGE SCENARIOS

In Portugal, the main research project in relation to climate change scenarios and adaptation is 'Scenarios, Impacts and Adaptation Measures' (SIAM), coordinated by the Faculty of Sciences of the Lisbon University.

SIAM I started in 1999 and carried out the first integrated evaluation of impacts and adaptation measures for climate change in continental Portugal in the 21st century based on different climatic and socio-economic scenarios⁷. The second phase of the project, SIAM II, started in 2002 and expanded its area of analysis to include the autonomous regions of Azores and Madeira. SIAM II was completed in 2006.

SIAM covers eight socio-economic sectors: water resources, coastal zones, agriculture, human health, tourism, energy, forests, biodiversity and fisheries. The chapter on coastal zones considers the impact of climate change with the increase in SLR based on the high IPCC 2001 scenario of 1 m SLR. The chapter on water resources in SIAM I considered only surface run-off, but in SIAM II was expanded to include underground water resources including run-off, aquifer recharge, groundwater levels, saltwater intrusion and some groundwater quality aspects. SIAM II highlights that further research is needed into changes in the quality of water resources as well as in demand as a result of climate change.

SIAM I and II were multidisciplinary studies that involved researchers, specialists and professionals from a range of different institutions, led by the *Faculty of Sciences of the University of Lisbon* with a total budget of €600 000. The project was funded by different ministries and for the second phase financing was also secured through the EU Structural Funds and the company BP Portugal.

Furthermore, a smaller three-year project called 'Portcoast'⁸, was carried out between 2005-2007 by the *Geophysics Centre and the Oceanography Institute of the University of Lisbon*, together with the *Meteorological Institute* and the *Marine Institute of the Azores* focusing on the vulnerability of coastal biological communities to climate change effects. Funding was provided by the Ministry of Science, Technology and Higher Education for an amount of €90 000.

⁷ SIAM used General Circulation Models, statistical models to explain, describe and predict global weather patterns under various conditions, including increased greenhouse gasses in the atmosphere, in order to produce assessments of climate change impacts.

⁸ Portcoast stands for 'Present and future Portuguese coastal climate and its impacts on biological communities'.

16.4. COASTAL DEFENCE, RISK REDUCTION AND ADAPTATION PLANS IN RELATION TO CLIMATE CHANGE

In Portugal, there is a hierarchy of strategic and spatial planning instruments for regulating the organisation and use of the national territory. With respect to the coastal zones, the Litoral 2007-2013 is the overarching policy document prioritising actions defined in the different Coastal Management Plans.

As to climate change, Portugal is still in a phase of research and monitoring. At policy level, climate change considerations are being taken account of and some of the strategies adopted aim at minimising the impacts in the long run. To date, the main policy actions are the National Climate Change Programme, the forthcoming National Climate Change Adaptation Strategy and the Strategic Plan for Water Supply and Sanitation.

16.4.1. CLIMATE RELATED STRATEGIES

Portugal has had a *National Climate Change Programme* in force since 2004. The programme aims to comply with the Kyoto protocol but does not yet address climate change adaptation.

As to the water sector, the *Strategic Plan for Water Supply and Sanitation* for 2007-2013 (PEAASAR II) guides the investments to be done in water supply systems in the programme period 2007-2013. While the plan does not deal with climate change issues as such, it identifies possible areas that could be included in the Research and Development Operational Programme 2007-2013⁹ such as the analysis of the consequences of climate change on the water sector (e.g. water stress and storm frequencies) and the development of mitigating measures. The implementation of the plan is supervised by INAG and IRAR.

At present, the water institute INAG¹⁰ is conducting *studies on climate change adaptation* for the water sector. The results so far highlight the major impacts of climate change expected on the water resources in Portugal¹¹. INAG will also identify the national framework (strategy, plan or law) for adaptation actions as well as concrete measures in the domains of water availability, water demand and flood protection. The INAG studies will serve as an input for a *National Climate Change Adaptation Strategy*. The strategy will include a chapter on water resources and is projected to be approved and included in the National Climate Change Programme in 2009.

⁹ Operational Programmes are supported by the EU Structural and Cohesion Funds.

¹⁰ INAG, among others, operates, on the basis of the 2005 Water Law, which transposes the EU Water Framework Directive into national law; Portugal has drawn up a National Water Plan and 15 River Basin Plans, none of them taking climate change into account at this stage.

¹¹ These impacts include overall annual runoff reduction, increase of regional and seasonal asymmetry in water availability, flood-risk increase particularly in the north, decrease in surface water quality particularly in the south, groundwater quality decrease and water demand increase.

Finally, the document *Basis for a National Integrated Coastal Zone Management Strategy*¹² recognises the severe problem of coastal erosion and the fact that the risks associated with climate change and SLR reinforce this concern.

16.4.2. INITIATIVES AT OPERATIONAL LEVEL

Whilst Portugal is not yet implementing actions specifically aimed at climate change adaptation, measures are undertaken to reduce the risk to people and property due to coastal erosion and indirectly to SLR. In this respect, Coastal Management Plans are the main instrument foreseen.

Actions to improve water management in Portugal are mainly carried out in the framework of the country's operational programmes 2007-2013, supported by the EU Structural and Cohesion Funds.

a/ Coastal Management Plans and Litoral 2007-2013

In Portugal, regional land use plans known as Coastal Management Plans (POOCs) are the main instrument regulating the management of the coastal zone¹³. POOC's are an instrument of the state to preserve the natural environment and maximise the natural value of the coastal areas. They cover the coastal strip up to a maximum of 500 m width and a maritime strip up to 30 m deep. Coastal defence against flooding, erosion or extreme weather events is only one of the aims of these plans. Other key objectives include the conservation of environmental and landscape values of the coastline as well as regulating the use of the beaches for touristic purposes.

The Strategic Coordination Group of the Ministry of Environment, Territorial Planning and Regional Development that is monitoring the implementation of the POOCs, has drafted the Litoral 2007-2013 document to prioritise the implementation of the actions defined in the POOCs. Litoral 2007-2013 focuses on areas where people and buildings are most at risk. Specific protection measures include a mixture of hard (e.g. groins and breakwaters) and soft (e.g. beach nourishment and dune recuperation) measures, as well as leaving some areas to a natural re-alignment, and relocating and retreat in other areas¹⁴.

The entire Portuguese continental coast, excluding port and military areas, is divided into 9 sections, each section being covered by a separate Coastal Management Plan covering a 10-year period. *Table 16-1* provides an overview of the nine different POOCs for the Portuguese coastal zone.

¹² MAOTDR, 2007a, *Bases para a Estratégia de Gestão Integrada da Zona Costeira (GIZC)*, Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional, Lisboa.

¹³ POOCs are binding upon lower level plans such as the Regional Land Management Plans (Planos Regionais de Ordenamento do Território - PROT), which are further broken down into Municipal Management Plans (Planos Directores Municipais - PDM).

¹⁴ Particularly for illegal occupations in the Public Maritime Domain which are in risk zones and coastal protection zones.

Table 16-1: Overview 9 POOCs for the Portuguese coastal zone

<i>POOC</i>	<i>Period</i>	<i>Area</i>	<i>Coastal protection budget (% of total POOC budget)</i>
<i>Caminha-Espinho</i>	1999-2009	Norte	€16.9 million (44%)
<i>Ovar-Marinha Grande</i>	2000-2010	Centro	€19.2 million (26%)
<i>Alcobaça-Mafra</i>	2002-2015	Lisbon & Tagus Valley	€12 million (49%)
<i>Sintra-Sado</i>	2003-2015	Lisbon & Tagus Valley	€1.1 million (14%)
<i>Cidadela-S.J. Da Barra</i>	1998-2009	Lisbon & Tagus Valley	€5 million (5%)
<i>Sado-Sines</i>	1999-2009	Alentejo	€0.02 million (0.16%)
<i>Sines-Burgau</i>	1998-2009	Alejepto & Algarve	€0.6 million (5.8%)
<i>Burgau-Vilamoura</i>	1998-2009	Algarve	€12 million (67%)
<i>Vilamoura-V R.S.A.</i>	2005-2015	Algarve	€16.9 million (13%)
TOTAL			€83.72 million

Climate and SLR scenarios were taken into consideration in the preparatory studies which preceded the development of the POOCs and looked into problems for various coastal sectors. However, it seems that in the end, only the POOCs of *Burgau-Vilamoura* and *Vilamoura-Vila Real de Santo António* took SLR into account. As a result, these POOCs include measures as the prohibition of building works in high risk zones and the removal of illegal constructions on barrier islands. Such measures also indirectly protect the coastal eco-systems.

Besides the POOCs for the nine coastal sections, dedicated management plans (POAPs)¹⁵ have been prepared for protected areas throughout Portugal such as natural parks and nature reserves. These plans take into account fauna, flora, geology and landscapes, and have rules and regulations which contribute indirectly to coastal defence, through the maintenance of these natural areas.

b/ Water related activities

As mentioned above, the Portuguese government has recently presented a plan for investments in water supply and waste water for the operational programming period 2007-2013. Many infrastructure

¹⁵ Planos de ordenamento das áreas protegidas.

investments have been made in water supply during the programming period 2000-2006. Besides the further improvement of distribution networks as well as leakage control, a key issue during the 2007-2013 period will be the role of price incentives in water supply management. Public awareness of water as scarce good is high and water prices are expected to rise in line with the EU Water Framework Directive¹⁶ requirements of cost recovery¹⁷. Climate change as such has not been referred to.

16.5. PAST, PRESENT AND FUTURE ADAPTATION EXPENDITURE

For Portugal, the adaptation expenditure has been split between the protection against flooding and erosion on the one hand and the actions to counteract freshwater shortage on the other hand. A small remark has been made with respect to the expenditure related to coastal eco-systems and wetlands.

a/ Flooding and erosion

In Portugal, the expenditure against flooding and erosion is funded by national as well as EU funds¹⁸. Most of the actions undertaken are detailed in the POOCs and implemented by INAG. Over the entire 1998-2015 period, the expenditure to protect the Portuguese coasts against flooding and erosion totals €131 million.

In 2008, the expenditure to protect the Portuguese coastal zones against flooding and erosion amounted to €11.72 million. Of this amount, 80% is equally divided between the construction and rehabilitation of hard protection structures, such as dikes and breakwaters, and soft measures including dune rehabilitation and beach nourishments. Indirect measures include preparatory studies to define the most appropriate measures as well as technical planning.

¹⁶ Directive 2000/60/EC of 23 October 2000 on establishing a framework in the field of water policy.

¹⁷ The 2005 Water Law introduced a water resource charge imposed on users of water resources in the public domain, on uses which may deteriorate water quality and on beneficiaries of public hydraulic works; the charge is meant to recover the scarcity and environmental cost of the water services and ought to be reinvested in the improvement of the quality of water bodies and efficiency of water use; GFK, 2006, *Strategic evaluation on environment and risk prevention under Structural and Cohesion Funds for the period 2007-2013*.

¹⁸ For the period 1998-2005, on average 30% is supported by EU funds per year.

Table 16-2: Expenditure to protect against coastal flooding and erosion (in € million)

Year	CAPITAL EXPENDITURE*			INDIRECT EXPENDITURE*	TOTAL***
	Hard	Mixed**	Soft		
1998	6.54	1.93	2.10	0.01	10.59
1999	3.68	3.79	0.95	0.02	8.44
2000	4.07	2.71	0.19	0.22	7.19
2001	3.31	3.09	0.69	0.37	7.46
2002	3.99	1.77	0.31	0.30	6.37
2003	6.56	0.61	0.04	0.30	7.52
2004	3.37	0.94	0.04	0.22	4.57
2005	4.62	1.33	0.58	0.22	6.75
2006	4.66	1.37	0.70	0.18	6.90
2007	1.23	1.63	0.24	0.32	3.42
2008	4.69	1.80	4.94	0.28	11.72
2009	3.80	n.a.	4.94	0.08	8.82
2010	n.a.	n.a.	4.94	0.08	5.02
2011	n.a.	n.a.	n.a.	n.a.	7.29
2012	n.a.	n.a.	n.a.	n.a.	7.29
2013	n.a.	n.a.	n.a.	n.a.	7.29
2014	n.a.	n.a.	n.a.	n.a.	7.29
2015	n.a.	n.a.	n.a.	n.a.	7.29
TOTAL	50.52	20.98	20.68	2.59	131.21
		92.17			

* Annual capital and indirect expenditures have been calculated and categorised by Policy Research based on detailed information provided by Portuguese authorities on all individual measures taken in the coastal zones for the period 1998-2008

** Measures such as the removal of groins and emergency works, have been categorised as mixed measures

*** Seen the high volatility in previous years Policy Research has used the average over the period 1998-2010 to forecast the expenditure up to 2015 as further details could not be provided by the Portuguese authorities

b/ Freshwater shortage

To date, the investment in water supply in Portugal is practically all public. The sources of funding for the investment in water supply in 2000-2006 have been the European Union (68%), the national government budget (21%) and the municipalities (11%). According to PEAASAR II, covering the 2007-2013 period, only 50% of the planned investment is to be funded by the EU or national budgets. Therefore, alternative funding sources are called for, either through price incentives and cost recovery or through the greater involvement of the private sector¹⁹.

Table 16-3 provides an overview of the planned investment for the period 2007-2013 under PEAASAR II. About 40% of the investment is aimed at the rehabilitation of existing infrastructure.

¹⁹ GFK, 2006, *Strategic evaluation on environment and risk prevention under Structural and Cohesion Funds for the period 2007-2013*.

Table 16-3: Overview investment cost under PEAASAR II (in € million)

Year	REGULAR EXPENDITURES		CAPITAL EXPENDITURES		TOTAL
	<i>Rehabilitation of existing drinking water treatment</i>	<i>Rehabilitation of existing water distribution networks</i>	<i>Construction of new drinking water treatment plants</i>	<i>Construction of new water distribution networks</i>	
2007	4.97	53.21	7.49	79.81	145.48
2008	4.97	53.21	7.49	79.81	145.48
2009	4.97	53.21	7.49	79.81	145.48
2010	4.97	53.21	7.49	79.81	145.48
2011	4.97	53.21	7.49	79.81	145.48
2012	4.97	53.21	7.49	79.81	145.48
2013	4.97	53.21	7.49	79.81	145.48
TOTAL	34.80	372.48	52.40	558.70	1018.38
	407.28		611.10		

c/ Eco-systems and wetlands

No budgets exist which directly relate to the protection against the loss of eco-systems due to climate change, because the overall objective is to return natural areas to – or maintain them in – their natural state. The type of interventions that do occur for the protection of eco-systems, have rather low investment cost, for example, the construction of walkways for people to access the beach without damaging the dune system.

16.6. PERSONS CONTACTED AND SOURCES OF INFORMATION USED

16.6.1. PERSONS CONTACTED

<i>Name</i>	<i>Organisation</i>
<i>Dr Andrade, Cesar</i>	University of Lisbon
<i>Dr Barbosa Araújo, Isabel</i>	Centro Interdisciplinar de Investigação Marinha e Ambiental
<i>Dr Bastos, Luisa</i>	Centro Interdisciplinar de Investigação Marinha e Ambiental
<i>Costa, João</i>	Department of Works, Protection and Security, Water Institute
<i>Carneiro, Ernesto</i>	Equipamento Infra-estruturas e Ambiente, Administração dos Portos de Setubal e Sesimbra
<i>Prof Duarte Santos, Felipe</i>	University of Lisbon
<i>João Pinto, maria</i>	Ministry for Environment, Territorial Planning and Regional Development
<i>Mota Lopes, António</i>	Portuguese Geographical Institute
<i>Leonardo, teresa</i>	Nature and Biodiversity Conservation Institute
<i>Prof Taveira Pinto, Francisco</i>	Universidade de Porto

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